

Evaluation of a smart fork to decelerate eating rate

Hermesen, Sander; Frost, Jeana H; Robinson, Eric; Higgs, Suzanne; Mars, Monica; Hermans, Roel C J

DOI:

[10.1016/j.jand.2015.11.004](https://doi.org/10.1016/j.jand.2015.11.004)

License:

Creative Commons: Attribution-NonCommercial-NoDerivs (CC BY-NC-ND)

Document Version

Peer reviewed version

Citation for published version (Harvard):

Hermesen, S, Frost, JH, Robinson, E, Higgs, S, Mars, M & Hermans, RCJ 2016, 'Evaluation of a smart fork to decelerate eating rate', *Academy of Nutrition and Dietetics. Journal*. <https://doi.org/10.1016/j.jand.2015.11.004>

[Link to publication on Research at Birmingham portal](#)

General rights

Unless a licence is specified above, all rights (including copyright and moral rights) in this document are retained by the authors and/or the copyright holders. The express permission of the copyright holder must be obtained for any use of this material other than for purposes permitted by law.

- Users may freely distribute the URL that is used to identify this publication.
- Users may download and/or print one copy of the publication from the University of Birmingham research portal for the purpose of private study or non-commercial research.
- User may use extracts from the document in line with the concept of 'fair dealing' under the Copyright, Designs and Patents Act 1988 (?)
- Users may not further distribute the material nor use it for the purposes of commercial gain.

Where a licence is displayed above, please note the terms and conditions of the licence govern your use of this document.

When citing, please reference the published version.

Take down policy

While the University of Birmingham exercises care and attention in making items available there are rare occasions when an item has been uploaded in error or has been deemed to be commercially or otherwise sensitive.

If you believe that this is the case for this document, please contact UBIRA@lists.bham.ac.uk providing details and we will remove access to the work immediately and investigate.

Introduction

Overweight is associated with a range of negative health consequences, such as type II diabetes, cardiovascular disease, gastro-intestinal disorders, and premature mortality¹. One promising means to combat overweight is through encouraging people to eat more slowly^{i.e.}¹³. People who eat quickly tend to consume more^{e.g. 2, 3, 4} and have a higher body mass index^{5, 6, 7, 8} while people who eat more slowly feel sated earlier and eat less^{9, 10, 11, 12}.

Unfortunately, eating rate is difficult to modify, due to its highly automatic nature¹⁴. In clinical settings, researchers have had some success changing behaviour using devices that deliver feedback in real time^{15, 16, 17}. However, existing technologies are either too cumbersome¹⁸ or not engaging enough¹⁹ for use in daily life contexts. Training people to eat more slowly in everyday eating contexts, therefore, requires creative and engaging solutions. The purpose of this paper is to present a qualitative evaluation of the feasibility of a smart fork to decelerate eating rate in daily life contexts. Furthermore, we outline the planned research to test the efficacy of this device in both laboratory and community settings.

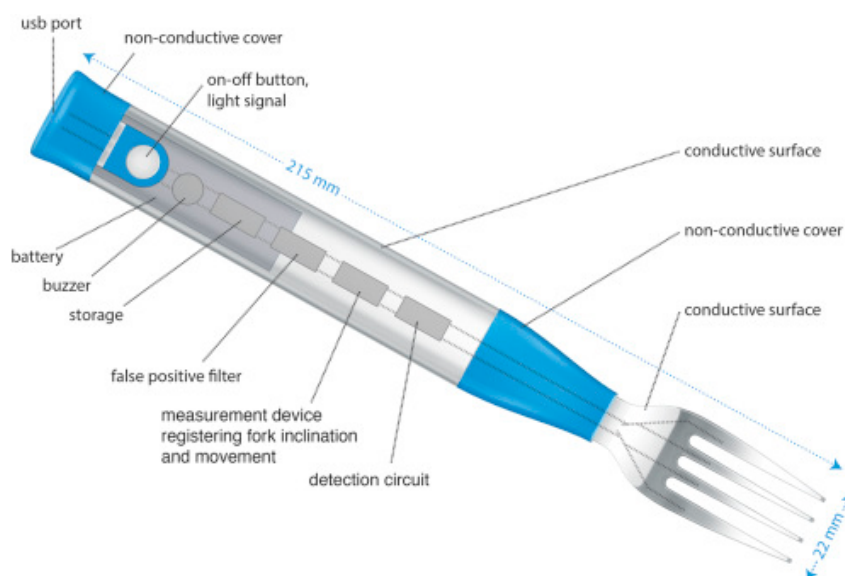


Figure 1: the 10sFork, produced by SlowControl (Paris, France). When taking a bite, the conductive surface on the fork prongs connects through the body of the user with the

conductive surface of the steel; this short circuit is detected, assessed, and if it represents a bite, its timestamp is stored. If two bits occur within a pre-set time limit, the fork delivers vibrotactile (buzzing) and visual (light) feedback. The fork weighs 83,5 grams and measures 215 x 22 x 13 millimeters (length x width x thickness).

Evaluation

Assessment

We performed a qualitative study to assess the acceptability, perceived efficacy and user experience of the 10SFork. The augmented fork contains sensors and actuators that provide real time feedback (see figure 1). The fork delivers feedback at 10-second intervals between bites. If users take a bite too quickly (i.e. before the end of the 10-second interval), they feel a gentle vibration in the handle of the fork and see a red indicator light.

The fork provides a series of data recording methods. First, the fork determines the exact time at which the meal is started and ended (i.e. meal duration). Second, it counts the total number of bites per meal and per minute (i.e. eating speed). Third, it calculates the average interval between bites and, fourth, determines the ratio of over-speed bites. The fork stores all data for later review via USB or Bluetooth. The desired interval between bites and feedback modalities (lights and vibrations) can be adjusted in an online control panel. In addition to the vibrotactile and visual feedback, the fork is connected to a secure online platform. After logging on to the platform, users can review their past behaviour: number of bites, percentage of bites eaten too quickly, and duration of the meals. Possibilities for sharing and integration with social media are provided.

43

44 To test this fork, 11 participants (3 male, 9 female, age 18–35, all self-perceived fast eaters
45 ($M=7.2$, $SD = 1.82$ on a scale from 1 to 10, where 1 is 'extremely slow' and 10 is 'extremely
46 fast') ate a meal using the fork in our laboratory. Subsequently they used the fork for three
47 consecutive days in their home setting, eating as many meals as possible with the fork. All
48 participants ate the main meal of the day, dinner, with the fork. Three participants also used
49 the fork for other meals including breakfast and lunch. After the laboratory meal and upon
50 returning the fork, participants shared their experiences in semi-structured interviews
51 covering the following topics: perceived effect on eating rate, comfort of use, feedback
52 accuracy, social aspects of fork use, and motivation for using the fork. Interviews were
53 recorded and transcribed, and a thematic classification on the transcripts was performed. The
54 study protocol was approved by the Institutional Review Board of the Faculty of Social
55 Sciences of <blinded for review>. All participants provided written informed consent.

56

57 **Participant feedback**

58 All participants felt that the feedback was generally accurate and consistent and found the
59 technology acceptable. Everyone found the fork's size and weight acceptable, felt the fork was
60 pleasant to handle, and felt that the fork's vibrotactile feedback was not uncomfortable, but
61 could not be ignored either. While each participant reported some false positives, e.g.
62 vibrations when not taking a bite, no participant saw that as a threat to the usability of the
63 fork. However, all participants found it hard to estimate when the ten-second wait was over.
64 Interviews suggest the fork may result in changes in both perceptions and behaviour. All
65 participants report a heightened awareness of eating rate and all but one participant reported
66 that they ate more slowly when using the fork. When eating in company, none of the
67 participants felt ashamed when using the fork; rather, it sparked humour and started some

lively conversations about eating rate and healthy eating. Surprisingly, a few participants reported some frustration with decelerated eating rate, expressing a desire to return to their former speedier eating habits.

All participants were motivated to try the fork. After a few meals, however, motivation waned in a minority of the participants; the majority remained motivated to use the fork throughout the three-day period. All participants could imagine the fork being effective in retraining eating rate in the long run. Yet, none of the participants felt they were part of the product target group, i.e. they did not perceive their high eating rate as a major problem for their health.

Conclusions

The 10SFork has the potential to become a successful intervention in slowing down eating rate. Users feel it is an acceptable product that is sufficiently comfortable and accurate. They report enhanced awareness of their eating rate and feel comfortable using the fork in social settings. However, self-perceived target group membership, and the incapacity of the fork to take meal characteristics into account, may be issues affecting acceptance of the fork as an intervention for healthy eating in real life.

To formally evaluate the efficacy of the 10SFork in slowing down eating rate, we have received funding of the Netherlands Organisation of Scientific Research (NWO). We will conduct two studies. The first study will assess the effect of the feedback on eating rate, satiety, and intake in a single, standardized meal. In the second study, we will examine the efficacy of the fork over time in naturalistic eating contexts. Results from these studies will contribute to answering the question of whether this tool can be a viable instrument to reduce eating rate, and control food intake.

References

- 93 1. Berenson GS. Health consequences of obesity. *Pediatr Blood Cancer*. 2012;58(1):117-
94 121.
- 95 2. Viskaal-Van Dongen M, Kok FJ, De Graaf C. Eating rate of commonly consumed foods
96 promotes food and energy intake. *Appetite*, 2011;56:25-31.
- 97 3. De Graaf C, & Kok FJ. Slow food, fast food and the control of food intake. *Nat Rev*
98 *Endocrinol*, 2010;6:290-293.
- 99 4. Robinson E, Almiron-Roig E, Rutters F, de Graaf C, Forde CG, Tudur Smith C, Nolan SJ,
100 & Jebb SA. A systematic review and meta-analysis examining the effect of eating rate on
101 energy intake and hunger. *Am J Clin Nutr* 2014;ajcn-081745.
- 102 5. Otsuka R, Tamakoshi K, Yatsuya H, Murata C, Sekiya A, Wada K, & Toyoshima H.
103 Eating fast leads to obesity: Findings based on self-administered questionnaires among
104 middle-aged Japanese men and women. *J EPIDEMIOLOG*, 2006;16:117-124.
- 105 6. Lee HA, Lee WK, Kong KA, Chang N, Ha EH, Hong YS, & Park H. The effect of eating
106 behavior on being overweight or obese during preadolescence. *J Prev Med Public Health*,
107 2011;44(5):226.
- 108 7. Tanihara S, Imatoh T, Miyazaki M, Babazono A, Momose Y, Baba M,& Une H.
109 Retrospective longitudinal study on the relationship between 8-year weight change and
110 current eating speed. *Appetite*, 2011;59:179-183.
- 111 8. Maruyama K, Sato S, Ohira T, Maeda K, Noda H, Kubota Y, ... & Iso H. The joint impact
112 on being overweight of self reported behaviours of eating quickly and eating until full:
113 cross sectional survey. *BMJ*, 2008;337.
- 114 9. Rolls ET. Sensory processing in the brain related to the control of food intake. *Proc Nutr*
115 *Soc*, 2007;66:96-112.
- 116 10. Zijlstra N, De Wijk R, Mars M, Stafleu A, & De Graaf C. Effect of bite size and oral
117 processing time of a semisolid food on satiation. *Am J Clin Nutr*, 2009;90:269-275.

11. Cassady BA, Hollis JH, Fulford AD, Considine RV, Mattes RD. Mastication of almonds: effects of lipid bioaccessibility, appetite and hormone response. *Am J Clin Nutr*, 2009;89:794–800.
12. Kokkinos A, Le Roux CW, Alexiadou K, Tentolouris N, Vincent RP, Kyriaki D, & Katsilambros N. Eating slowly increases the postprandial response of the anorexigenic gut hormones, peptide YY and glucagon-like peptide-1. *J Clin Endocrinol Metab*, 2010;95:333–337.
13. Martin CK, Anton SD, Walden H, et al. Slower eating rate reduces the food intake of men, but not women: implications for behavioral weight control. *Behav Res Ther*, 2007;45(10):2349-2359.
14. Petty AJ, Melanson KJ, & Greene GW. Self-reported eating rate aligns with laboratory measured eating rate but not with free-living meals. *Appetite*, 2013;63:36-41.
15. Berg C, Sabin M, Shield J, et al. A framework for the treatment of obesity: early support. *Obesity: causes, mechanisms, preventions, and treatment*. Sunderland: Sinuaer Associates, Inc; 2008:399-425.
16. Ford AL, Bergh C, Södersten P, et al. Treatment of childhood obesity by retraining eating behaviour: randomised controlled trial. *Bmj*, 2010;340.
17. Van Elburg AA, Hillebrand JJG, Huyser C, et al. Mandometer Treatment Not Superior to Treatment as Usual for Anorexia Nervosa. *Int J Eat Disord*, 2011;45:193-201.
18. Zandian M, Ioakimidis I, Bergh C, et al. Decelerated and linear eaters: effect of eating rate on food intake and satiety. *Physiol Behav*, 2009;96(2):270-275.
19. Hamilton-Shield J, Goodred J, Powell L, et al. Changing eating behaviours to treat childhood obesity in the community using Mandolean: the Community Mandolean randomised controlled trial (ComMando)-a pilot study. *Health Technol Assess*, 2014;18(47):1-75.

